Photolysis and Radiolysis on the Surface of the Icy Satellites

Robert E. Johnson (Univ. of Virginia)

In this paper the available laboratory data on photolysis and radiolysis of ice is summarized for the purpose of interpreting remote sensing data on the icy satellites. It is pointed out that the dominant species seen in laboratory spectra can differ from those seen in space but in regions with temperatures always < 100 K the band at 0.28 μm, associated with trapped OH as well as bands (< 0.25 μm) associated with HO_2 and H_2O_2 will produce a general reddening below ~ 0.4 μm and may be detectable. In addition, the luminescence produced by plasma bombardment may be observable by spacecraft on the night-side of certain icy satellites [1]. The energetic incident ions also produce vacancies and intersitials which migrate under annealing to form clusters of vacancies, called voids, and to form molecules. The H_2 and O_2 molecules formed at a defect or at a surface, from diffusing O and H interstitials, can either escape at the vacuum interface in the porous regolith or become trapped in the voids forming bubbles. The bubbles will form preferentially at interfaces in a "dirty" ice and will predominantly contain O_2 [2], which diffuses through ice much less efficiently than H_2. Photolysis in such a micro-O_2 atmosphere leads to formation of O_3 [3]. Introducing the interaction of $O(^1D)$ with O_3 into the Chapman equations gives a ratio O_3/O_2 of $\sim 2 \times 10^{-4}$, close to the ratio estimated by Noll et al. [4] from HST observations.

[1] R.E. Johnson and T.I. Quickenden (1996). Submitted for publication.

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Paper presented by Robert E. Johnson
Engineering Physics
Thornton B103
Univ. of Virginia
Charlottesville VA 22903 USA
Phone: 804-924-3244
Fax: 804-924-1353
Email: rej@virginia.edu

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